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sity to accept the corresponding position in Vassar College.

DR. LAWRENCE E. GRIFFIN has been appointed professor of zoology in the University of Pittsburgh.

DR. ROBERT M. OGDEN, of the University of Tennessee, secretary of the American Psychological Association, has accepted the chair of psychology at the University of Kansas.

DR. FRIEND E. CLARK has resigned his position as professor of chemistry in Center College, Danville, Ky., to become professor of chemistry in West Virginia University.

SAMUEL W. GEISER, B.S. (Upper Iowa, '12), has been appointed professor of biology at Guilford College, North Carolina.

DEAN A. WORCESTER, B.A. (Colorado, '11), has been appointed associate professor of psychology in the University of New Mexico.

DR. HAROLD CHAPMAN BROWN, of Columbia University, has been appointed assistant professor of philosophy in Stanford University.

IRENE HUNT DAVIS, instructor in chemistry at the University of Washington, has been promoted to be assistant professor of chemistry.

THE following have been recently appointed to positions in George Peabody College for Teachers: Mr. Charles C. Colby, from the Minnesota State Normal School, as associate professor of geography; Miss Ada M. Field from Teachers College; Miss Blanche Evelyn Hyde from Newton, Mass., as assistant professors of home economics; Dr. William F. Russell, honorary fellow in Teachers College, as associate professor of secondary education. Dr. Leonidas C. Glenn, professor of geology, and Dr. John J. Luck, assistant professor of mathematics, of Vanderbilt University, have been secured to give special courses at the college.

DR. THEODORE SHENNAN, at present pathologist to the Royal Infirmary of Edinburgh, has been appointed regius professor of pathology (Sir Erasmus Wilson Chair) in the University of Aberdeen, in the place of the late Professor George Dean.

DISCUSSION AND CORRESPONDENCE

DO AZOTOBACTER NITRIFY?

UNDER the caption of "Fixation of Atmospheric Nitrogen" Mr. Dan. H. Jones, in the *Transactions* of the Royal Society of Canada, Third Series, 1913, Vol. III., Sect. IV.,¹ gives the results of certain experiments tending to show that the azotobacter form nitrates in their body tissues. He states:

Cultures of each variety in Ashby's solution when one month old gave the nitrate reaction with phenolsulphonic acid colorimetric test. As the cultures get older, up to several months, the reaction to the test gets slightly stronger. This nitrate is retained almost altogether in the bodies of the organisms. Cultures filtered through Berkefeld filter gave only a trace of nitrate in the filtrate and a strong reaction in the mass of organisms which did not pass through the filter. The filtrate plated out showed that some of the organisms had passed through the filter. But as it took about ten days to filter enough for a test it is possible that the organisms had grown through the filter in that time. Probably the presence of a small number of organisms in the filtrate was responsible for the trace of nitrate in the tests. Mass growths on Ashby's agar, when mature, gave a strong nitrate reaction.

The author does not state to what extent pigmentation had taken place, but as the material experimented with represented old cultures it is probable that a considerable degree of pigmentation was present. He says:

As the cultures get older, up to several months, the reaction to the test gets slightly stronger.

The present writer was deeply interested in this subject in connection with work which he was doing in 1910 and 1911 and stated in describing some samples of soil used in studying the subject of fixation,² that

a certain sample gave, at the beginning of the experiment, an unsatisfactory growth of azotobacter but thirteen days later another culture made from the same sample gave a heavy membrane in four days on which brown points developed on the eighth or ninth day.

Again on page 93 of the same bulletin it is stated:

¹ The title of the article is "A Morphological and Cultural Study of Some Ozotobacter."

² Bull. 178, p. 87, Colo. Expt. Sta., 1911.

The question of whether the azotobacter both fix the atmospheric nitrogen and convert it into nitric acid, respectively nitrates, or whether this latter work is done wholly by another genus or other genera of bacteria is, perhaps, a question to be settled, but, be it settled as it may . . . we have instances of the accumulation of very large quantities of nitrates in our soils always associated with the brown color which we know to be caused by the azotobacter. I believe, and this belief is based upon tentative facts, that the azotobacter are at the same time nitrifiers, *i. e.*, that they possess a double function, which, I believe, has already been asserted, but not generally accepted.

This subject has not been referred to in later bulletins because I believe that my tentative facts were interpreted wrongly.

The tentative facts referred to were, in the first place, that with pure cultures made on sand I obtained a decided color reaction with phenolsulfonic acid which might readily be taken for the reaction due to nitric acid, in the second place, the power of pigmentation in successive cultures of azotobacter weakens and finally disappears. The loss of this power of pigmentation is not permanent, for, as Professor Sackett has since shown, the addition of a very small amount of a nitrate to the culture medium restores it.

I interpreted the former fact, the reaction with phenolsulfonic acid, as rather strong proof of the presence of nitric acid and the latter fact as supporting this view. It seemed to me that the second fact given, *i. e.*, the weakening of the power of pigmentation, pointed to an ability of the azotobacter to nitrify in a limited measure and that this function was lessened in the succeeding generations grown on mannite-agar until it finally vanished while the purely vegetative function was retained apparently unimpaired. With these facts and views in mind I wrote the sentences quoted from Bull. 178 of this station but I was very far from being satisfied with the tentative facts. At my request Professor Sackett kindly made other cultures from two of his stock cultures which had shown marked ability to form pigments. These cultures were

made on a much larger scale than those previously made on sand and were allowed to incubate till the pigments were well developed. The membranes were removed from the agar and the agar washed with distilled water. The wash water was rendered alkaline by the addition of sodic carbonate and evaporated to dryness. The membrane that had been removed was added to the residue and the whole was thoroughly mixed and dried. A portion of the dried mass was tested with phenolsulfonic acid and yielded a deep brown solution which, on sufficient dilution, gave a yellow color with a tinge of brown. A most excellent imitation of those unsatisfactory solutions sometimes obtained on applying this test to samples of soils. We tried such means as were at our command to remove the brown color or tinge which does not belong to the nitric acid reaction but without success. We rejected this phenolsulfonic acid test because the results were so doubtful that we considered them valueless in this particular case.

A larger portion, in fact all that we had left of the dried membrane, was treated with ferrous chlorid and hydrochloric acid with all of the precautions demanded by this method. The volume of gas evolved was only 2.3 c.c. which was transferred to an absorption burette and a freshly boiled, concentrated ferrous chlorid solution allowed to flow into the gas. No absorption took place and no brown color was produced on the margins of the slowly inflowing stream of ferrous chlorid solution which constitutes an exceedingly delicate test for nitric acid. These results indicated that our previous caution was fully justified and that the color obtained with phenolsulfonic acid was due, not to nitrates but to the action of the reagents upon the substances in the membrane itself, most probably upon the pigments.

We may add apropos to these pigments that while they are difficultly soluble or insoluble in the menstrua usually used, pure water, alcohol, etc., the presence of various salts in aqueous solution cause them to dissolve to a greater or less extent; one, which, in some cases, is sufficient to impart a yellowish-brown color to the solution. We have often met with this in ma-

king aqueous extracts of our brown soils. The phenolsulfonic acid test for nitric acid is not applicable to such soils due to the interference of these pigment reactions. We were not satisfied with the results obtained in the experiments already given so we repeated them on a still larger scale, but with the same results which we consider as positively establishing the fact that the azotobacter do not nitrify but that the pigments which they form may give with phenolsulfonic acid, especially in very dilute solutions, a color reaction deceptively similar to that given by nitric acid and this reagent.

WM. P. HEADDEN

COLORADO EXPERIMENT STATION,
FT. COLLINS, COLO.

NORTHERN LIGHTS IN SUMMER

I live at Nett Lake, Minnesota, 140 miles northwest of Duluth and 38 miles south of Fort Frances, Ontario, Canada. On the night of July 4 there was a fine display of northern lights (aurora borealis). It was as fine a display as is seen in this section even in the coldest months. There were spires and rolls of light and a bow of light which covered the whole northern sky and towards midnight reached nearly to the zenith.

ALBERT B. REAGAN

NETT LAKE, MINN.,
July 6, 1914

SCIENTIFIC BOOKS

The Cambridge Manuals of Science and Literature. Edited by P. GILES and A. C. SEWARD. New York, G. P. Putnam's Sons.

A review of the Cambridge Manuals appeared in SCIENCE of April 18, 1913; but since that date numerous additional volumes have come to hand, dealing with the most diverse topics. I give a list, with a few comments.

The Flea. By HAROLD RUSSELL.

When, some years ago, a member of the wealthy house of Rothschild took to collecting and describing fleas, there was a tendency to regard the circumstance in a humorous light, and perhaps even to enquire whether a man, to whom so many doors of opportunity were open, could not find something better to do.

To-day, the connection between fleas and the plague having been established, Rothschild finds himself the greatest living authority on a subject of the highest importance to medical men, and no well-informed person has anything but praise for his work. The oriental rat-flea, the one mainly concerned in the spread of bubonic plague, was first made known to science by Rothschild, and the development of psyllology is illustrated by the collection of about a hundred thousand specimens at Tring.

Mr. Russell has had the advice of Mr. Charles Rothschild, and we may assume that his readable little book is up-to-date. It should be in the hands of medical men and the public generally, especially in regions where fleas are abundant. We would venture to suggest that if another edition appears the exceedingly crude text-figures should be replaced by better ones; that on page 81, in particular, is really scandalous.

Bees and Wasps. By O. H. LATTER.

This also is illustrated by very rough figures, without much pretence to accuracy in detail. The point of view is strictly British, but as many genera are common to Europe and America, the descriptions are more or less applicable to our species. The excellent accounts of the habits of English bees and wasps could scarcely at present be duplicated in this country, owing to the lack of observations. The work of the Peckhams on the solitary wasps, and that of various American observers on particular species of bees and wasps, is quite as good as anything done in Europe; but we still remain largely or wholly ignorant concerning the habits of many of our genera.

The Life Story of Insects. By G. H. CARPENTER.

This book is well illustrated, and the author has not hesitated to borrow many of his figures from American sources. The treatment of the subject is broad, and although the work has only 134 pages, Professor Carpenter manages to convey a great deal of information in an interesting way. This is, I think, the best brief introduction to entomology yet published.